



CA Wind Resource Potential

Dora Yen-Nakafuji

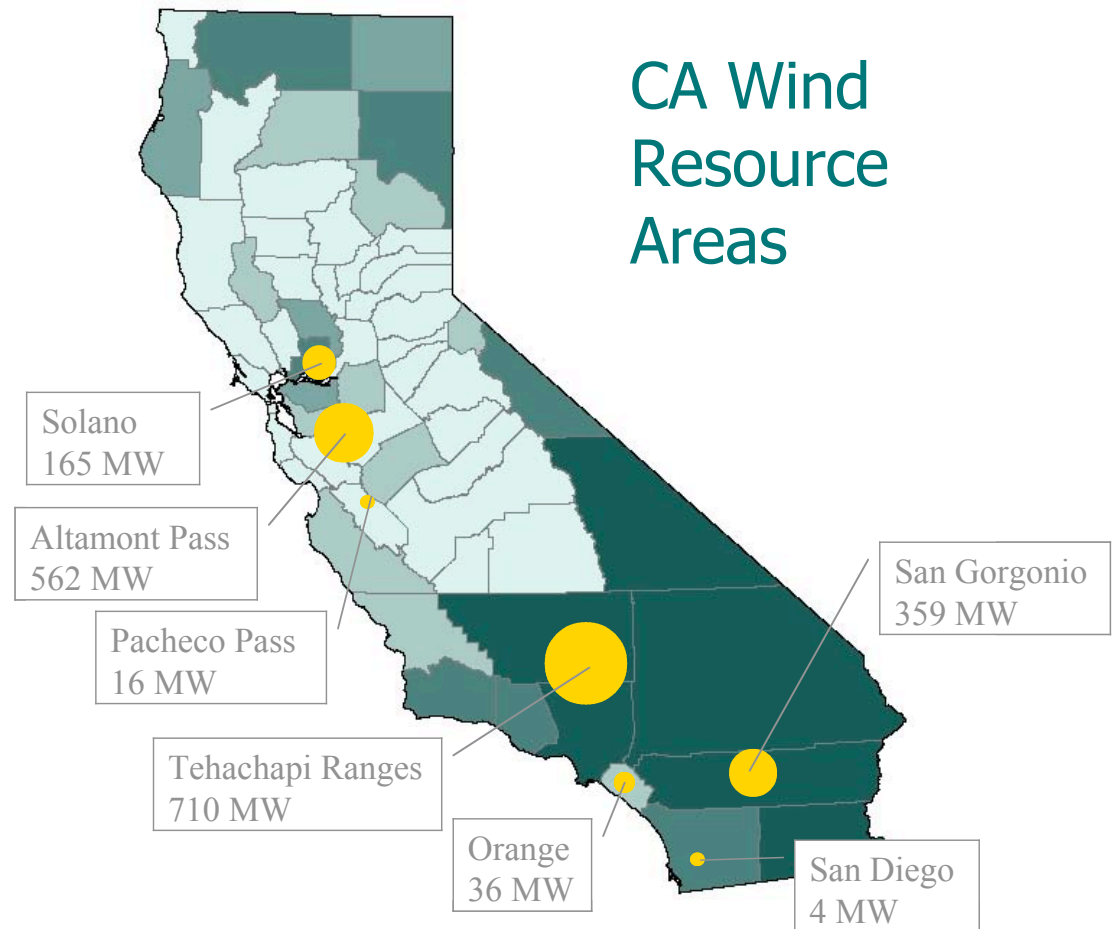
PIER Renewables R&D

California Energy Commission



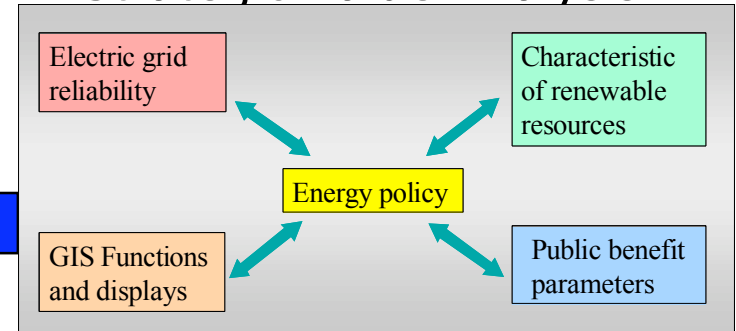
Overview

- ◆ *Goals for wind*
- ◆ *SVA Approach*
- ◆ *Wind resource assessment*
- ◆ *Technical Results*
- ◆ *Summary*



Wind Goals

Strategic Value Analysis



◆ Assess & prioritize CA wind development

- Develop reliable wind assessments and performance trends
- Re-power existing sites & new high-speed and low-speed wind resources close to transmission corridors

◆ Reduce wind intermittency issues

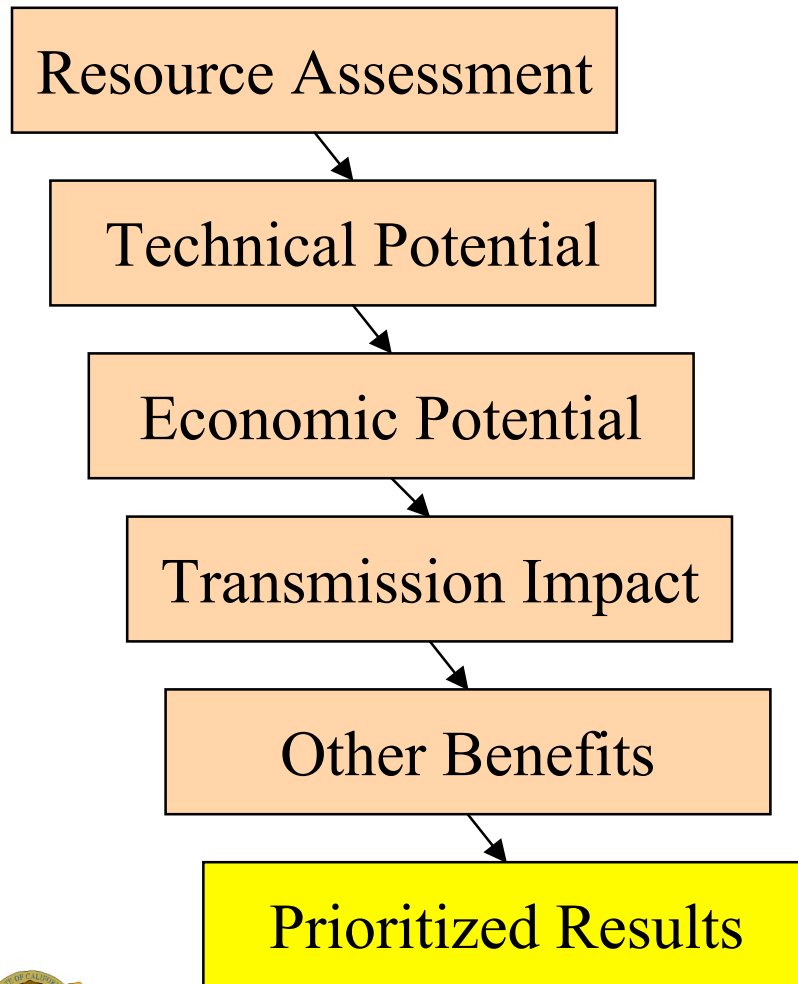
- Develop wind forecasting capability
- Demonstrate intermittency management strategies

◆ Increase wind energy market penetration

- Meet Accelerated Energy Action Plan of 20% by 2010
- Maintain 20% renewable generation by 2017 – RPS goal



Strategic Value Analysis Approach

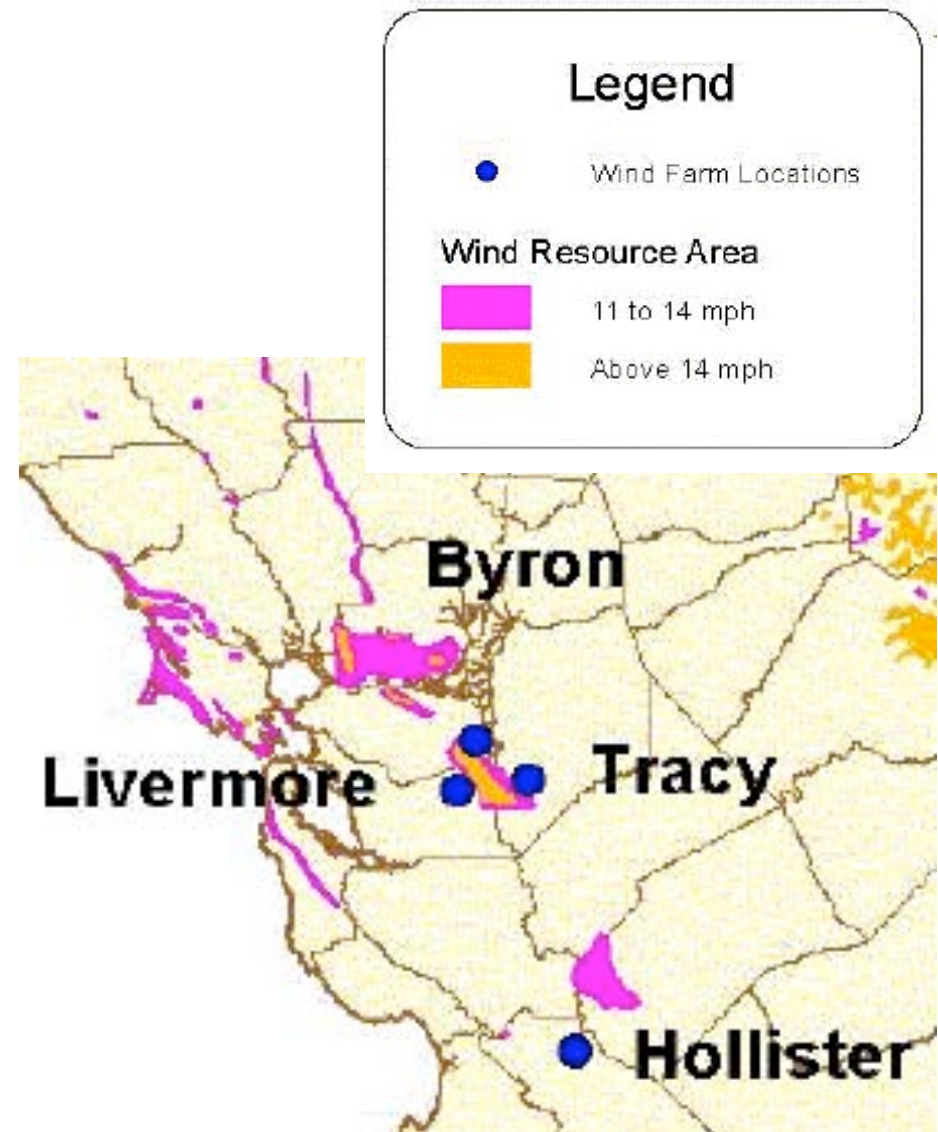
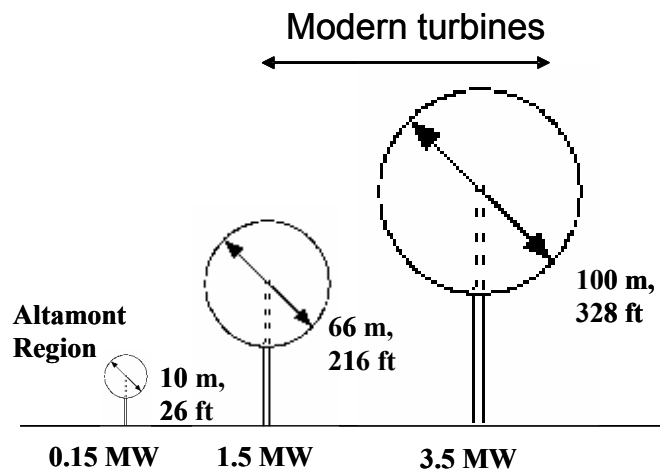


- ◆ *Identify resource potential and filtering criteria (technical & economic)*
- ◆ *Optimize development and deployment of renewables based on their benefits*
 - *Electrical grid*
 - *Environment*
 - *Local Economies*
- ◆ *Overlay renewable technologies by location to find optimal mix for development*
- ◆ *Graphically display and integrate solutions for planning needs*



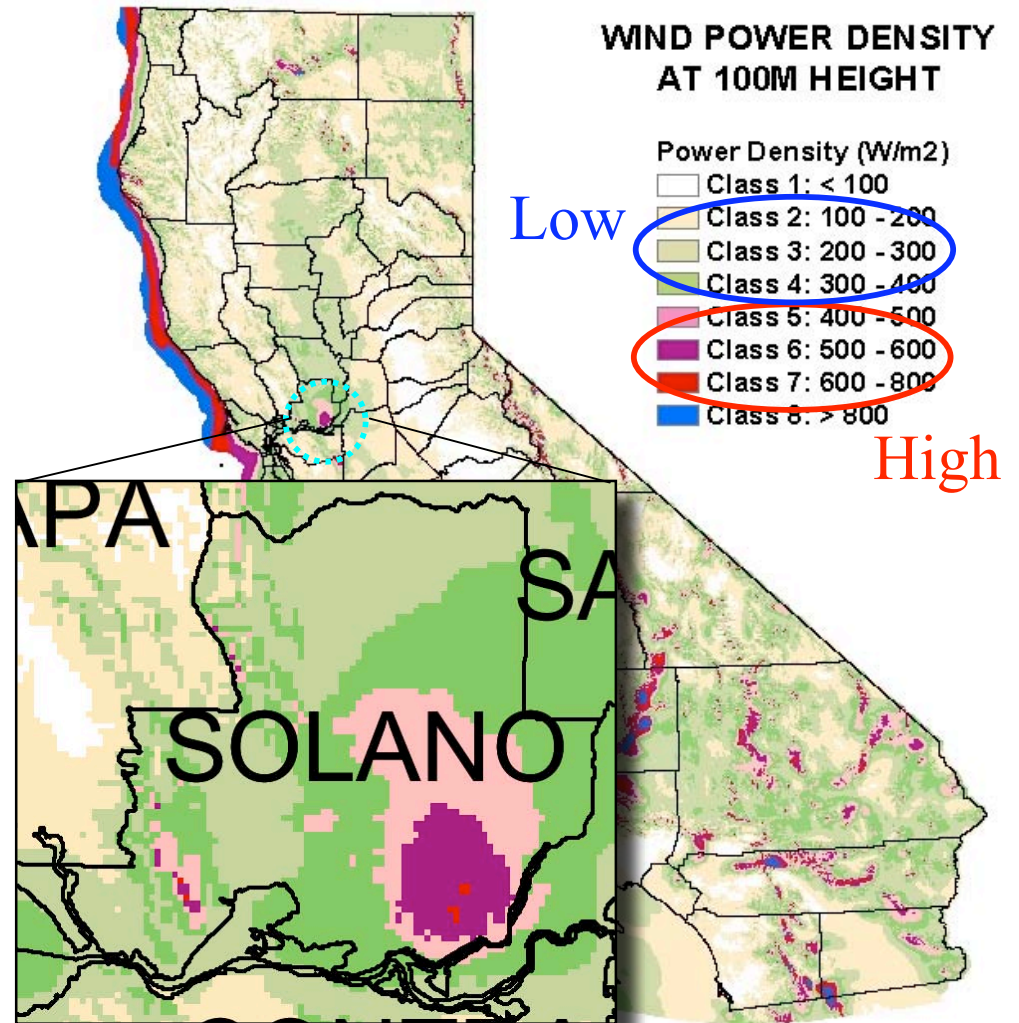
History of Characterizing the Wind

- ◆ *Assessment based on 1980s technology*
- ◆ *Validation data (10-30m towers)*
- ◆ *Subjective contours*
- ◆ *Inadequate height and resolution for wind development needs*

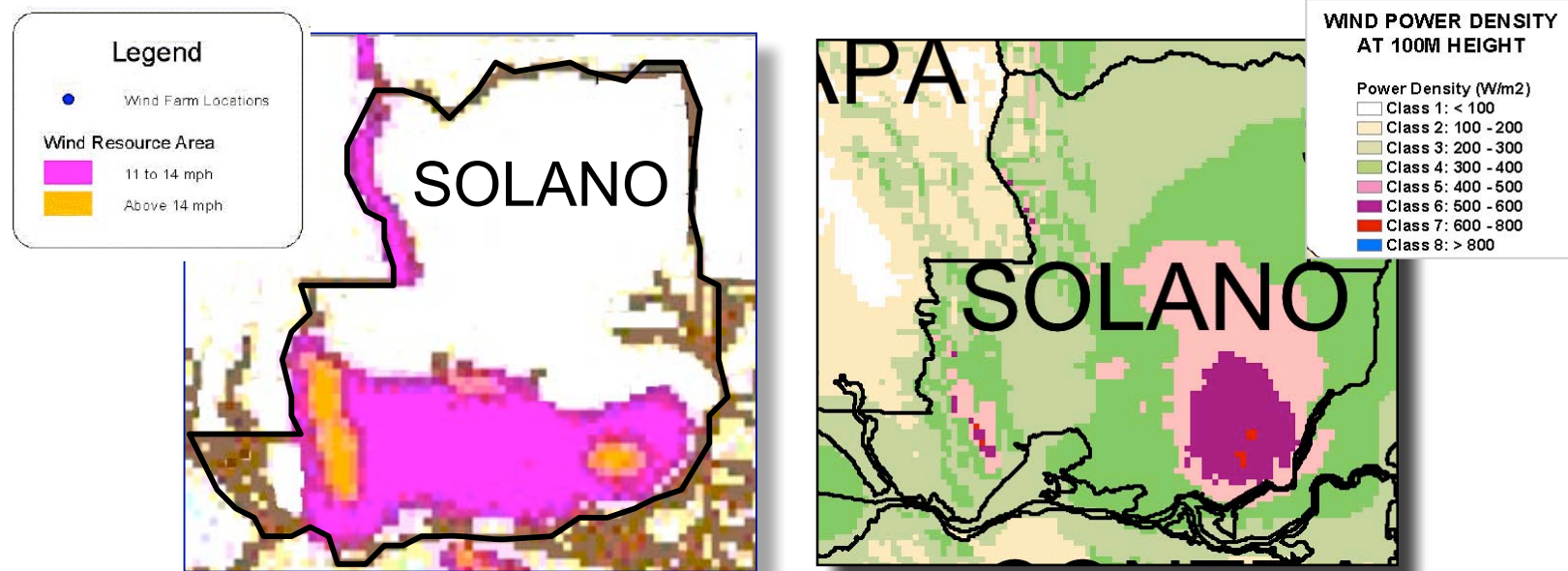


Updated Wind Resource Assessments

- ◆ New high resolution, physics-based maps for CA wind resources
 - 200×200 m **vs** kilometer resolution
 - Multi-level wind speed & power (30m, 50m, 70m, 100m) **vs** 10 m level
- ◆ Wind resource characterization
 - High speed wind
 - Low speed wind
- ◆ Urban wind monitoring



Increased Data Quality and Confidence



- ◆ *Refine locations for new development*
- ◆ *Identifies additional land area for wind development*



CA Wind Potential – 70m



UTILITY WIND RESOURCES
POWER DENSITY AT 70M HEIGHT

Wind Power Density W/m²

- < 300 with all other constraints *
- ≥ 300 without constraints *

* Constraints including:

- Coastal zone
- Sensitive habitat - Coastal Scrub
- Stream management zones - 200 ft. buffer
- Reserves
- Forest, water, wetland, and urban areas

Gross Wind Potential: 295,187 MW

Technical Potential*: 99,945 MW

Current Installed: 2,000 MW

Opportunity: 97,945 MW

Technical Filters (excluded areas):*

Resource > 300 W/m²

Topography grade > 20%

Bodies of Water

Forested Areas

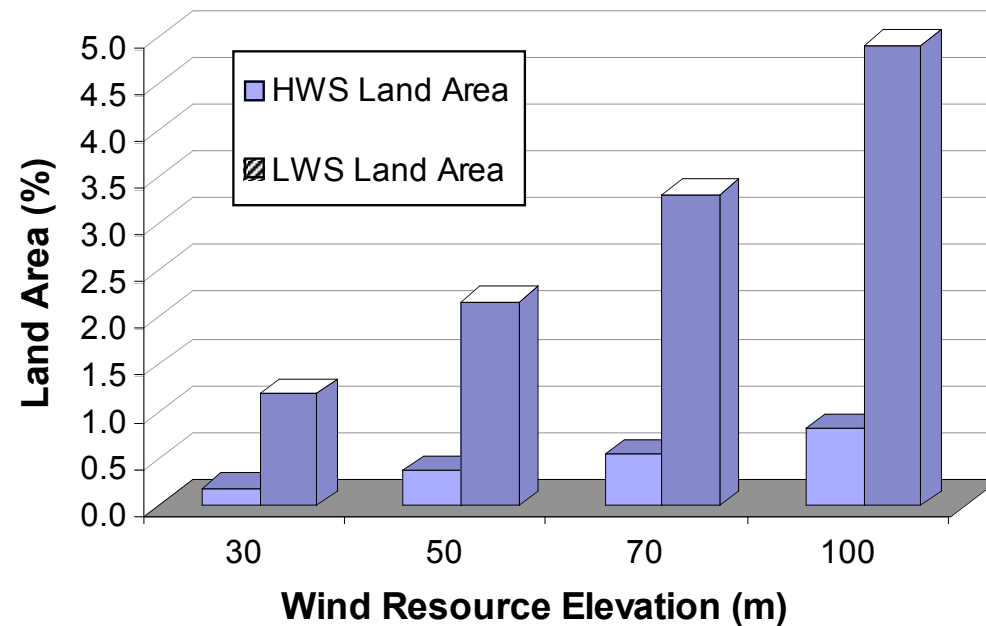
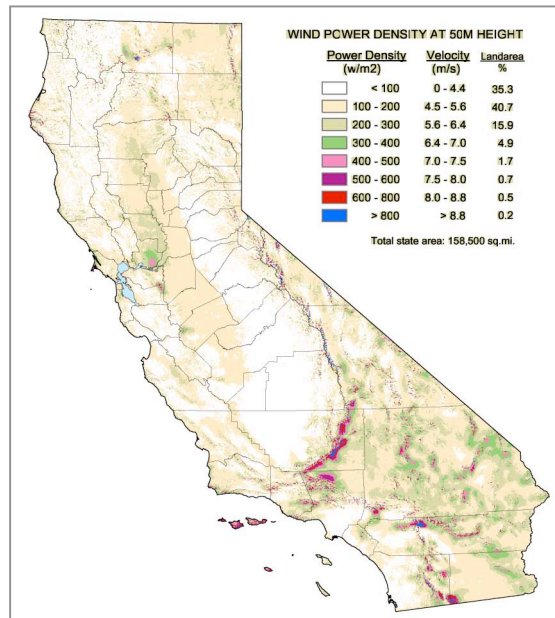
Urban Areas

State/National Parks & Monuments

Others (Natural Reserves)



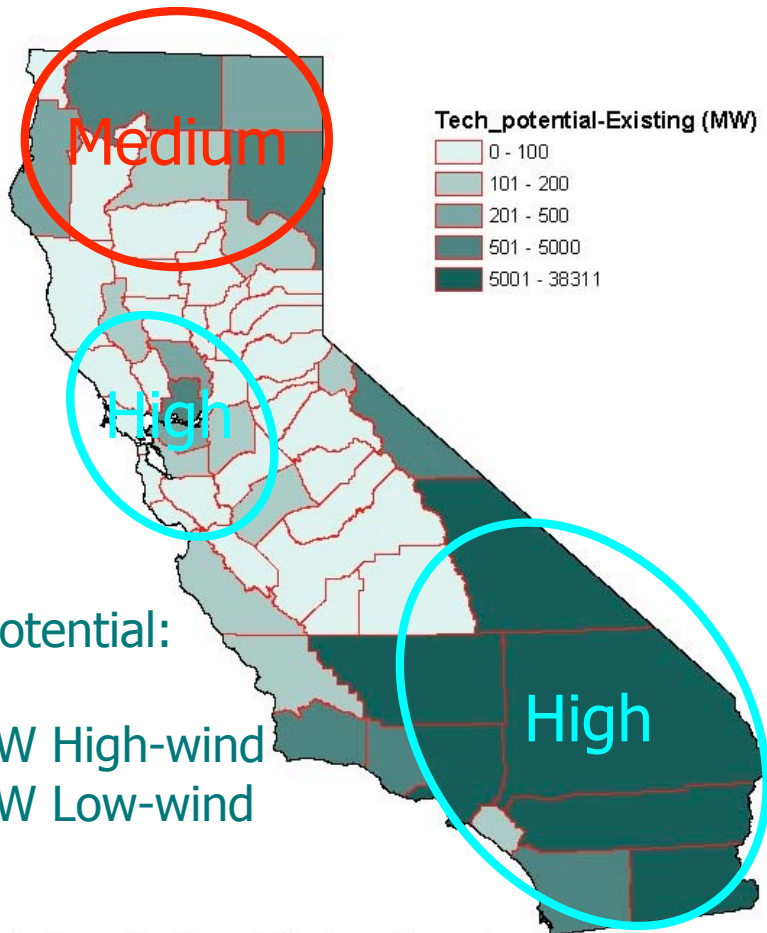
Technical Wind Potential



Height m	High Wind Speed			Low Wind Speed		
	Land Area Percent	Capacity MW	AEP GWh	Land Area Percent	Capacity MW	AEP GWh
30	0.2	4775	15478	1.2	30897	100144
50	0.4	9586	31070	2.2	56196	182144
70	0.6	14346	46500	3.3	85598	277441
100	0.8	21339	69164	4.9	126558	410199



Prioritized Development

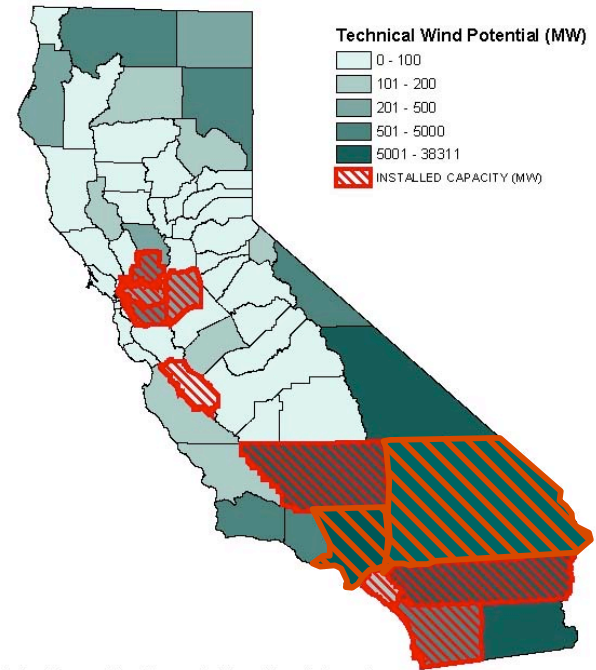


Technical Potential:
99,945 MW

- 14,346 MW High-wind
- 85,598 MW Low-wind

Technical wind potential at 70 meter height minus existing capacity

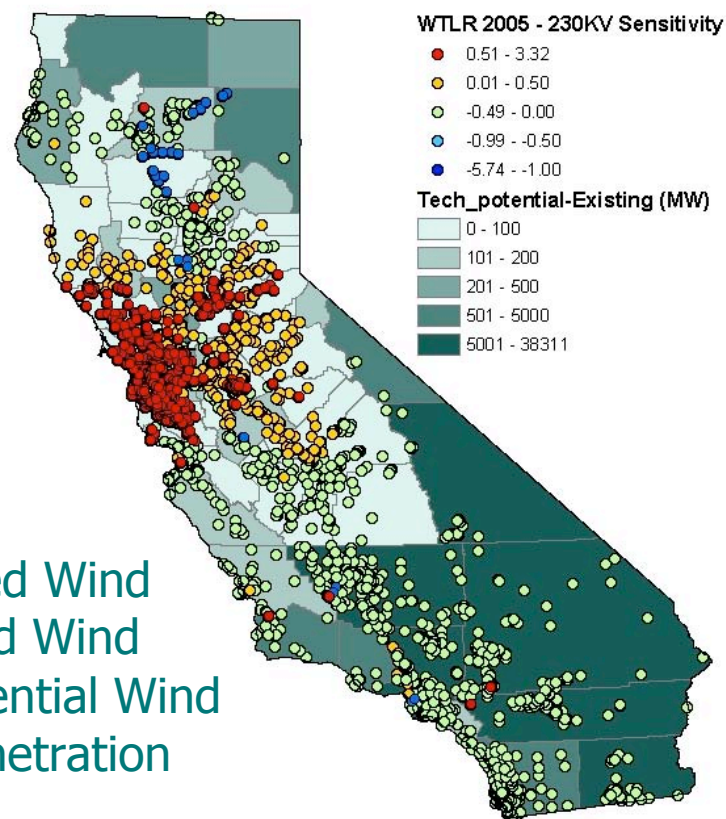
*Existing 2000 MW in
11 Counties*



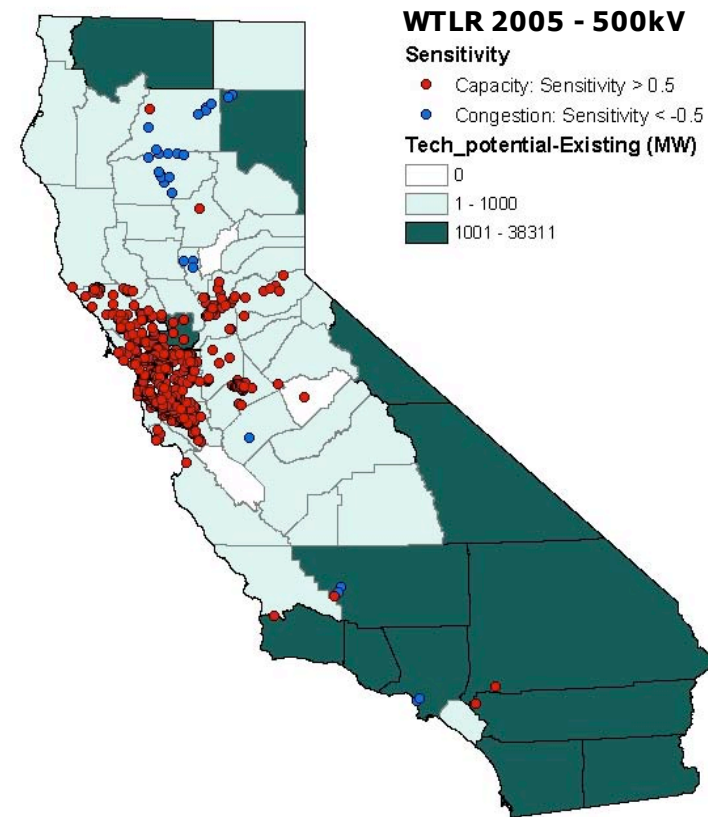
Technical wind potential at 70 meter height and installed capacity



Scenario Analysis - with Transmission



Technical Wind Potential at 70 meter height minus existing developed



Technical Wind Potential at 70 meter height minus existing developed

Scenarios:

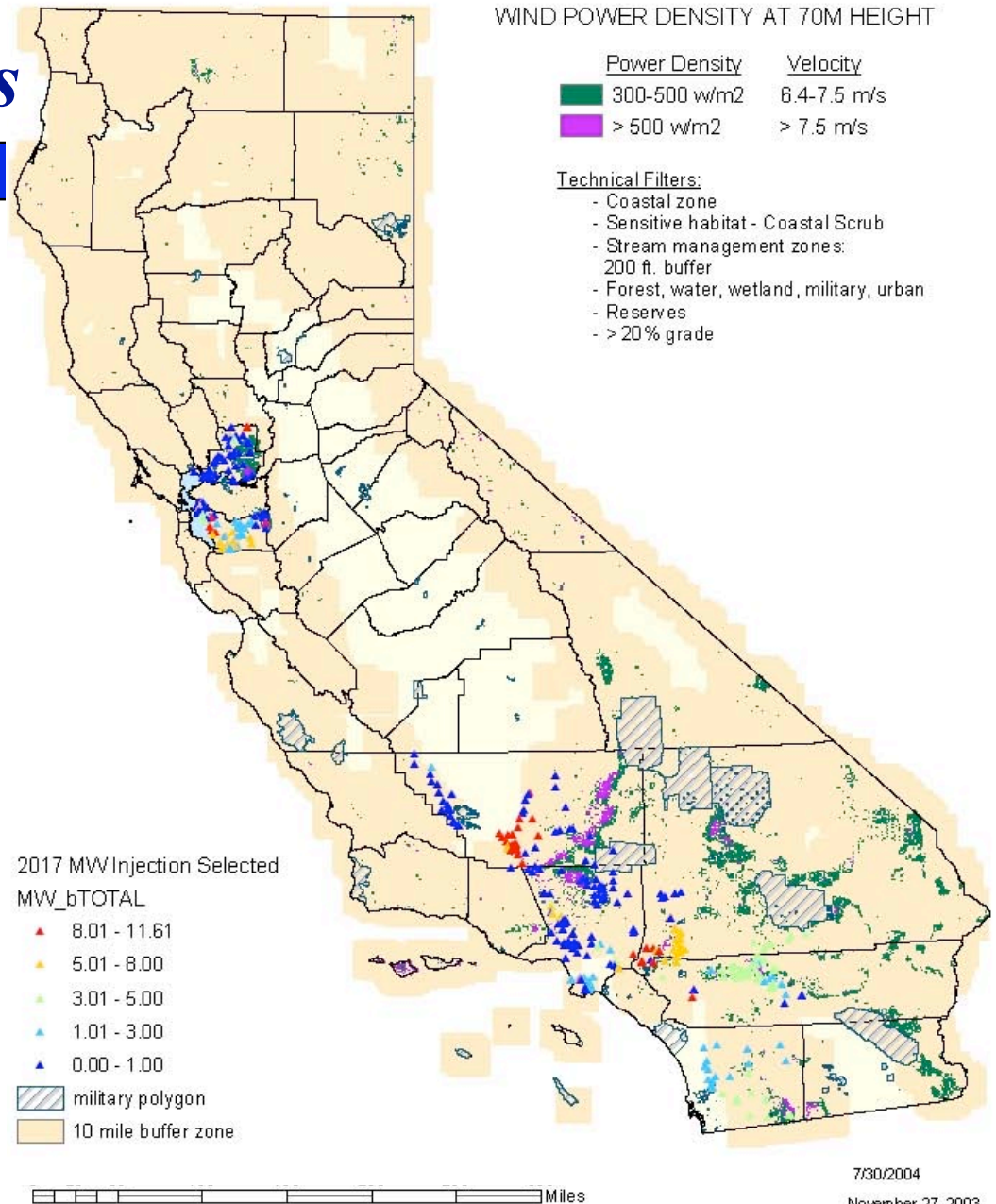
- High Speed Wind
- Low Speed Wind
- DG/Residential Wind
- Urban penetration



Transmission Analysis

Steps:

- *Overlay of transmission hotspots*
- *Select wind energy injection locations & potential*
- *Assess benefit to grid of single resource*
- *Assess benefit to grid of integrated resources*



7/30/2004

November 27, 2003

PUBLIC INTEREST ENERGY RESEARCH
"Research Powers the Future"



Summary

- ◆ Significant wind resource potential in CA
- ◆ SVA provides near/long term strategic approach for CA wind development (2010 to 2017 outlook)
 - *Support re-powering of existing sites*
 - *Locate & prioritize development of new high speed wind resource sites*
 - *Develop low speed wind resource sites with emerging wind turbine technology*
 - *Couple development to maximize benefit to grid and to ratepayers*
 - *Plan for DG & new building-integrated wind generation technologies*
- ◆ Provides a strategic “roadmap” for integration of wind resource in a balanced renewable portfolio

